

## New burrowing mayflies from Africa (Ephemeroptera: Ephemeridae)

by

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*Eatonica crassi* spec. nov. and *Ephemerella mooiana* spec. nov. are described and figured; their relationships to other ephemerids are discussed.

During the course of a study to determine the phylogenetic relationships between genera of Ephemeridae, a number of specimens representative of the Ethiopian fauna were examined. Among the material borrowed, a new species of *Ephemerella* from Natal was discovered, and several specimens from Africa in the collection of the University of Utah proved to be a new species of *Eatonica*. The two new species are described here and their relationships to other ephemerids are discussed.

### *Eatonica crassi* spec. nov., fig. 1

MALE IMAGO (in alcohol). Length: body 16-17 mm.; forewing 13 mm. Head pale fuscous to grayish dorsally, ivory anteriorly, bases of ocelli black. Antennae ivory throughout. Compound eyes black. Thorax ivory with brown longitudinal markings on either side of pronotum and light brown shading laterally on prothorax and mesothorax anterior to forewing bases. Forelegs light golden-brown, tinged with dark brown at junctures of segments, last tarsal segment brown, becoming dark brown at claws. Middle and hind legs ivory to pale fuscous throughout. Wings hyaline, costal area of forewings slightly dulling, crossveins dark brown. Abdominal terga (fig. 1A) ivory with brown markings as follows: tergites 1-7 with pair of longitudinal, laterally arched stripes broadening medially at posterior bases and also laterally to lateral margin of abdomen in tergites 1 and 2, short median longitudinal dashes in tergites 2-7, appearing continuous between segments in some specimens, tergites 8 and 9 with pair of lateral longitudinal stripes connected posteriorly with pair of median longitudinal stripes, median stripes convergent anteriorly, more so in tergite 8, tergite 10 with pair of short lateral dashes. Abdominal sterna (fig. 1B) ivory, sternites 2-9 with short brown longitudinal spots at anterolateral margins. Genitalia (fig. 1C) with subgenital plate short, posterior margin nearly straight, second segment of forceps strongly curved in distal half and not broadening at apices, penes broad basally, divergent in distal half by a narrow V-shaped notch, penial lobes narrowing only slightly and blunt apically with only slight terminal indentation, terminal aperture evident in ventral view. Caudal filaments ivory.

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**FEMALE IMAGO** (in alcohol). Length: body 17–21 mm.; forewing 18–20 mm. Head ivory dorsally with pair of brown spots between compound eyes near posterior margin of head, bases of ocelli black. Antennae ivory. Compound eyes black. Body and legs ivory to pale fuscous with lateral light brown markings on thorax, appearing reddish-brown and more diffuse in some specimens, claws of all legs brown. Wings as in male. Abdominal colour pattern corresponding to that of male except usually fading in posterior segments. Other characters as in male except for usual sexual differences.

**MATURE NYMPH.** Unknown.

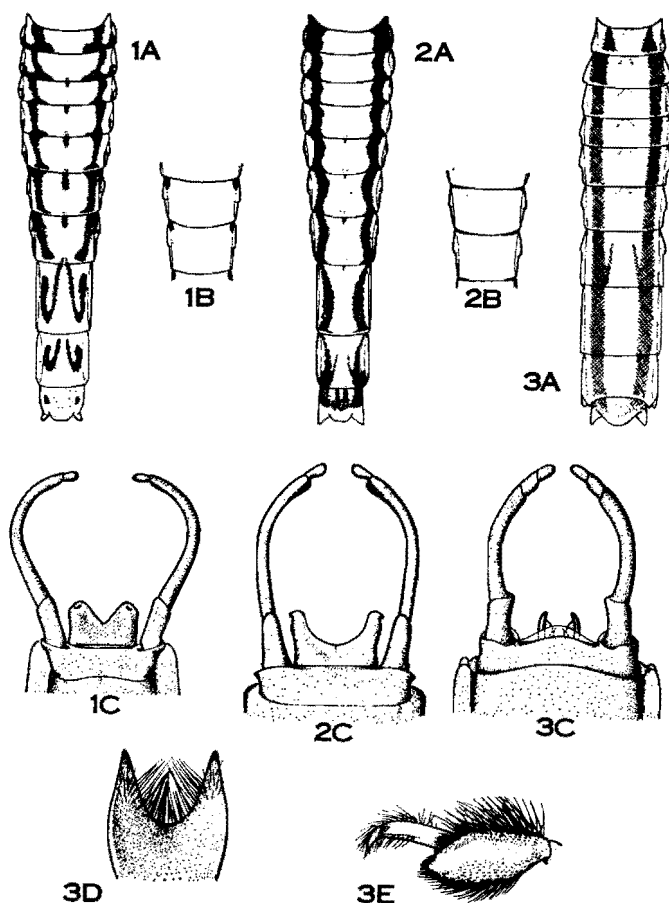
**MATERIAL EXAMINED.** ♂ Holotype; Sudan, Kosti to Malakal, White Nile; 28.x.1948, J. C. Bradley. ♀ Allotype; same data as holotype. Paratypes: 1 ♂ imago; Sudan, Equatoria, Torit, 700 m.; 21.x.1949, H. Hoogstraal; 1 ♀ imago; same data as holotype. All types have been deposited in the collection of the University of Utah, Salt Lake City. Also examined: 6 ♀ imagos; Tanganyika, Lake Victoria, near Bukoba; H. Copley; no other data; 1 ♀ subimago; same data as holotype; 1 ♂ and 2 ♀ subimagos; Nyasaland, Ntundu; 11.viii.1952, L. Berner.

## Discussion

After being placed variously in the genera *Ephemera*, *Hexagenia*, *Eatonica*, and *Pentagenia* by several workers, *Eatonica schoutedeni* (Navas) was clearly shown by Lestage (1918, 1924) to represent a new well-defined genus *Eatonica*, a name originally proposed by Navas (1913). The species also has to its credit a long list of synonymies reviewed by Barnard (1932) and Lestage (1945). It is likely that specimens of *E. crassi* have previously been collected and identified as *E. schoutedeni*, since the genus has been thought to be monospecific. The differences described below, however, show the former to be distinct from *E. schoutedeni* yet having typical generic characters of *Eatonica*. It is with pleasure that I have named this new species after Mr. R. S. Crass of the Natal Parks, Game and Fish Preservation Board, Pietermaritzburg, who has worked on the African Ephemeroptera, and assisted me in obtaining specimens for study.

*E. crassi* differs from *E. schoutedeni* primarily in the structure of the male genitalia. The penes of *E. crassi* (fig. 1C) are stout, terminally blunt, and divergent with a narrow V-shaped notch. Also, in the specimens I have seen, apertures are visible ventrally near the apices of the penal lobes. The penes of *E. schoutedeni* (fig. 2C), although rounded apically, possess small acute subapical projections arising laterally, and the penal lobes are separated by a broad U-shaped excavation. Needham (1920) figured the genitalia of a specimen identified as *E. schoutedeni*, and showed the penal lobes separated by a narrow V-shaped notch. This may have been due to the fact that the drawing was made from a single dry specimen; alternatively, it may mean that the shape of the notch is variable. The second segment of the forceps of *E. schoutedeni* tends to broaden apically (fig. 2C), whereas it does not in *E. crassi* (fig. 1C).

The two species also differ somewhat in the dorsal abdominal colour pattern. The pairs of stripes found in *E. schoutedeni* (fig. 2A) are slightly arched medially, but are straight to slightly concave on their inner margin in *E. crassi* (fig. 1A). The median dashes on the dorsum of the abdomen, and also the median pair of stripes in tergites 8 and 9, are usually much more pronounced in *E. crassi*. Tergite 10 is more pigmented in *E. schoutedeni*. In *E. crassi* the anterolateral markings on the abdominal sterna (fig. 1B) appear more elongated and less transverse than the corresponding markings of *E. schoutedeni* (fig. 2B). The colour pattern in the subimagos of *E. crassi* is generally similar to that of the imagos, but usually has more contrast.



Figs. 1-2. *Eatonica* spp. 1. *Eatonica crassi* spec. nov. 2. *Eatonica schoutedeni* (Navas). Fig. 3. *Ephemera mooiana* spec. nov. A. Male abdomen, dorsal view. B. Male abdominal segments 6 and 7, ventral view. C. Male genitalia, ventral view. D. Frontal process of nymph. E. Fore tibia of nymph.

Dr. Richard W. Koss, who is currently preparing an exhaustive study of Ephemeroptera eggs, has found that the eggs of *E. crassi* possess poorly developed chorionic ridges, while those of *E. schoutedeni* possess strongly developed ones. Moreover, he has found additional differences in the chorion, attachment structures, and micropylar device, all of which serve to differentiate the two species on the basis of the eggs. Dr. Koss plans to describe the detailed morphology of these two egg types in work to be published in the near future. Since females are somewhat difficult to differentiate specifically, the study of eggs taken from the abdomen facilitates specific identification. This procedure is of special importance in differentiating subimagos.

The nymphal stage of *E. crassi* is unknown but is presumably of a type similar to the nymph that Demoulin (1968) tentatively described as *E. schoutedeni*, many characters of which correspond to those of the genus *Hexagenia*. This would be expected in view of phylogenetic relationships. The reduced frontal process and terminal shape of the tibiae of the forelegs which Demoulin has figured make it distinct. Precise ecological information regarding *Eatonica* nymphs is lacking at present; presumably, however, their biology is similar to that of related Ephemeridae.

*E. schoutedeni* is reportedly widespread throughout most of Africa. The specimens of *E. crassi* that have been examined have a comparatively more limited distribution, ranging from Sudan to Nyasaland. These preliminary data suggest that *E. crassi* may have a more northerly range; however, an understanding of the zoogeography of the two species must necessarily await a re-examination of present collections and a more thorough knowledge of the faunal affinities of African mayflies.

***Ephemera mooiana* spec. nov., fig. 3**

MALE IMAGO (in alcohol). Length: body 22 mm.; forewing 18 mm. Head ivory dorsally with pair of faint light brown spots between compound eyes, ivory anteriorly, bases of lateral ocelli and area between ocelli brown. Antennae ivory with terminal segments becoming pale fuscous. Compound eyes grayish-black throughout. Pronotum ivory, fuscous laterally. Mesothorax and metathorax fuscous, notum brown laterally. Legs ivory to pale fuscous. Wings hyaline, venation light yellowish-brown, no shading present, crossveins not conspicuously crowded at bullae. Abdominal terga (fig. 3A) ivory with pair of fuscous stripes continuing the entire length. Abdominal sterna ivory, sternite 9 with pair of pale fuscous longitudinal lateral stripes. Genitalia (fig. 3C): subgenital plate narrow relative to abdominal segments with posterior margin slightly convex, forceps bases only slightly projected beyond posterior margin of subgenital plate, subgenital plate membrane transparent, convex, and covering proximal half of penes, basal segment of forceps approximately two fifths of length of second segment, titillators slightly convergent distally, acute apically, and much shorter than penes.

FEMALE IMAGO. Unknown.

MATURE NYMPH (in alcohol). Length: body 24–25 mm.; caudal filaments 7–9 mm. Body generally ivory to pale fuscous. Frontal process (fig. 3D) fuscous, becoming light brown at margins, lateral margins slightly rounded, margin of concavity with long golden setae. Pedicel of antennae with 2–3 stout setae ventrally near distal margin. Head usually light brown dorsally, compound eyes black; labrum slightly emarginate in median third. Pronotum fuscous. Tibiae of forelegs (fig. 3E) notched apically beyond tarsal socket. All legs with golden setae. Gills ivory. Caudal filaments ivory with ivory setae laterally along entire length.

MATERIAL EXAMINED. ♂ Holotype; South Africa, Natal, Mooi R., Sect. 45; R. S. Crass; no other data. Deposited in South African Museum (Natural History), Cape Town. The following have been associated with the holotype: 4 nymphs with same data as holotype; 3 nymphs; South Africa, Natal, Middle Mooi R., Nottingham Rd. Dist.; K. H. Barnard; no other data. The nymphs will also be lodged in the South African Museum.

## Discussion

*E. mooiana* is a typical species of *Ephemera* and at the same time is closely related to *Afromera natalensis* (Barnard), *A. congolana* Demoulin, and *A. aequatorialis* (Kimmins). The characters relegated to generic importance by Demoulin (1955) to distinguish the genus *Afromera*, namely the dimorphic shape of the tarsal claws of the forelegs and the highly concave posterior margin of the subgenital plate, are not found in *E. mooiana*, and may perhaps prove to be of specific importance only. Although the marginal wing venation is somewhat reticulate in *E. mooiana*, I believe this character (also used by Demoulin) to be insignificant, since Holarctic specimens of *Ephemera*, which I have examined, exhibit specific and even individual variability regarding it. It becomes obvious that the status of *Afromera* is in doubt, and the taxon, no matter what its rank, may be an unnatural one.

On the basis of the male genitalia, *E. mooiana* can be easily differentiated from the above-mentioned species. It differs from *A. natalensis* and *A. congolana* in possessing a subgenital plate (fig. 3C) slightly convex at the posterior margin rather than deeply concave as in the latter two. The subgenital plate of *E. mooiana* is also narrower in comparison with abdominal segment 9, and the basal segment of the forceps is relatively somewhat shorter than in *A. natalensis* and *A. congolana*.

In other characteristics of the genitalia, *E. mooiana* resembles most closely *A. aequatorialis* as figured by Kimmins (1956). It differs, however, in that the lateral margins of the subgenital plate are straight in *E. mooiana* but convergent posteriorly in *A. aequatorialis*, and the posterior margin is more convex in *E. mooiana*. In addition, the length of the titillators relative to that of the penes is much shorter in *E. mooiana*, and Kimmins does not show in *A. aequatorialis* a subgenital plate membrane such as is found in *E. mooiana*.

The dorsal abdominal colour pattern of *E. mooiana* (fig. 3A) appears to correspond most closely with that of *A. natalensis* and to be considerably different from that of *A. aequatorialis*.

The nymphal stage of *E. mooiana* is only tentatively described as such, because the nymphs examined were merely associated with the imago, and the identity was not established by rearing them to the imaginal stage. It is very possible that these nymphs are the same as those originally described by Crass (1947) as *Eatonica schoutedeni*, but later shown not to be by Demoulin (1968). The colour pattern on the nymphs I have tentatively called *E. mooiana* is badly faded and therefore of no aid in resolving the problem. On the other hand, the terminal notched condition of the forelegs (fig. 3E) is peculiar to these nymphs but atypical for *Ephemera* in general. It appears to correspond to the foreleg figured by Crass. Also, some of the nymphs Crass worked with were taken from the same general area as were the nymphs I have studied. Demoulin thought that the nymphs identified by Crass were *A. natalensis*, but here again no rearing has as yet been undertaken to establish exact relationships. Crass (1947) treated the biology of these nymphs.

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